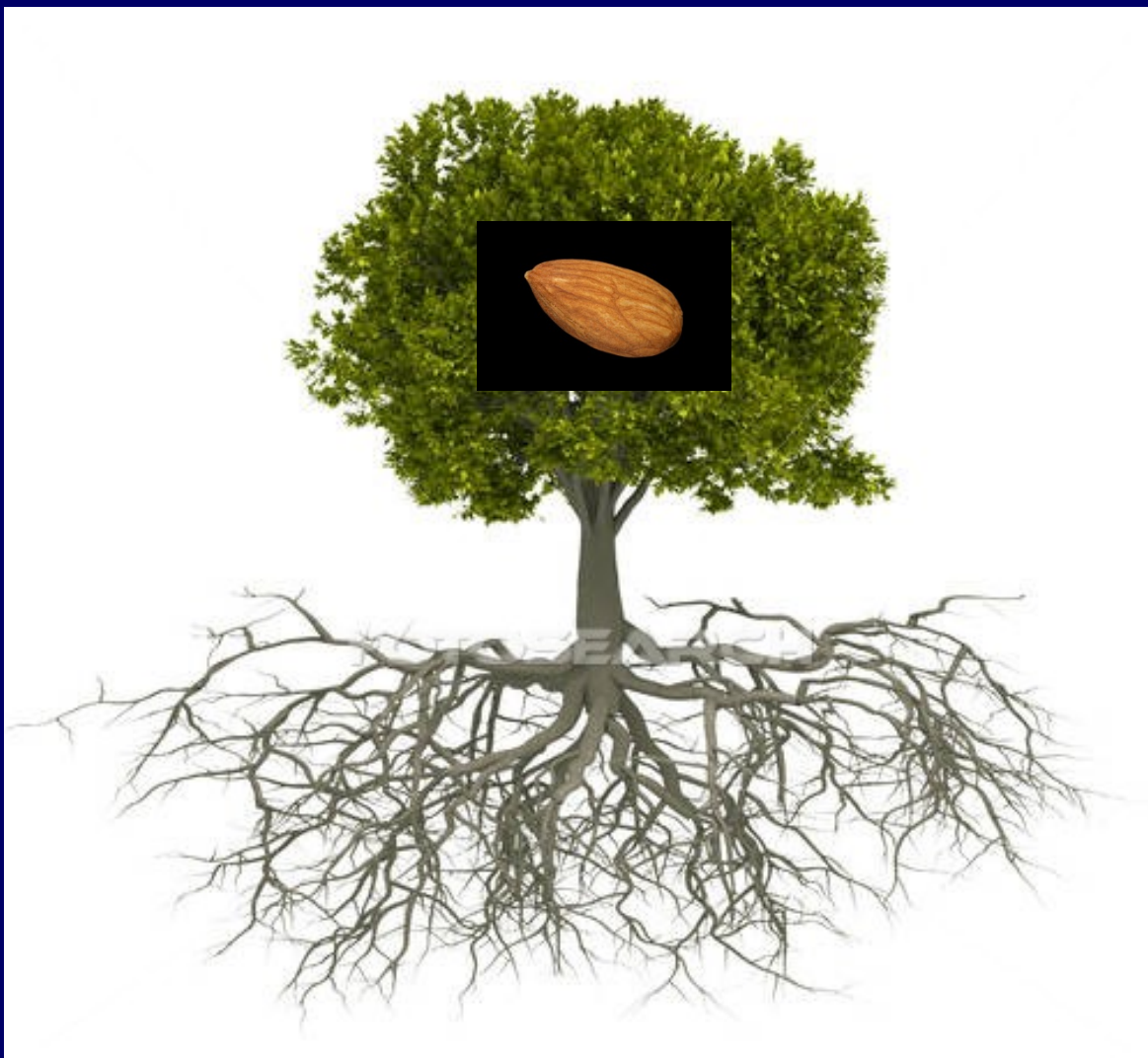


Choosing the Best Almond Rootstock for Your Orchard



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What is the best rootstock?

- Rootstock choice should be site specific

What Do We Want in an Almond Rootstock?

- **Compatibility**
- **Strong vigor / high yield efficiency**
- **Good anchorage**
- **Low / no suckering**
- **Tolerance to “heart rot” / wood decay fungi**

Nemaguard

■ Advantages

- “Immune” to rootknot nematode
- Vigorous rootstock
- Compatible with all almond varieties
- Performs well in sandy loam & loam soils
- “Decent” anchorage

Nemaguard

- Disadvantages
 - *Susceptible to:*
 - Ring & root lesion nematodes
 - Bacterial canker
 - High soil pH / high lime
 - Salt (sodium, chloride, boron)
 - Phytophthora / “wet feet”
 - Oak root fungus
 - Crown gall
 - “Heart” rot / wood decay fungi

Lovell

- Very similar to nemaguard in many ways
 - About 90% the size of nemaguard in sandy loam soils
 - A little better than nemaguard in heavy soil
 - Highly susceptible to rootknot nematode
 - More tolerant to ring nematode than most other commercial stocks

Peach / Almond Hybrids

- Includes Hansen, Nickels, Bright's Hybrid Cornerstone, Titan Hybrid, Paramount
- **Advantages**
 - Very high vigor
 - Tolerant to high lime / high pH soils
 - Tolerant to high boron, sodium & chloride
 - Very good anchorage
 - Resistant to rootknot nematode

Peach / Almond Hybrids

■ Disadvantages

- Very high vigor
- Highly susceptible to ring nematode and bacterial canker
- Highly susceptible to most root diseases
 - Phytophthora
 - oak root fungus
 - crown gall

Nemaguard

Nickels

5th leaf



**Yield (kernel pounds per acre) of Nonpareil & Carmel Almond Trees
in 2010 (8th Leaf) & Cumulatively (4th – 8th Leaf).**

	Nonpareil		Carmel	
	2010 (8 th leaf)	Cumulative (4 th – 8 th leaf)	2010 (8 th leaf)	Cumulative (4 th – 8 th leaf)
Paramount	--	--	3600 a	17,075
Nickels	3204 a	14,719	3529 a	18,744
Hansen 536	3139 a	15,113	3549 a	17,415
Cornerstone	2907 a	14,460	--	--
Empyrean #1	2668 ab	14,194	3405*	16,914*
Atlas	2599 b	12,428	3111 ab	16,140
Avimag	2328 bc	12,059	3085 ab	14,786
Viking	2235 bc	11,447	2569 b	13,354
Guardian	2143 bc	11,273	2398 b	12,391
Lovell	2103 bc	10,897	2455 b	11,486
Nemaguard	1946 c	10,884	2614 b	11,884
Empyrean 101	1357 d	6,028	--	--
Empyrean 2	965*	5,182*	1268*	--
Julior	--	--	924*	--

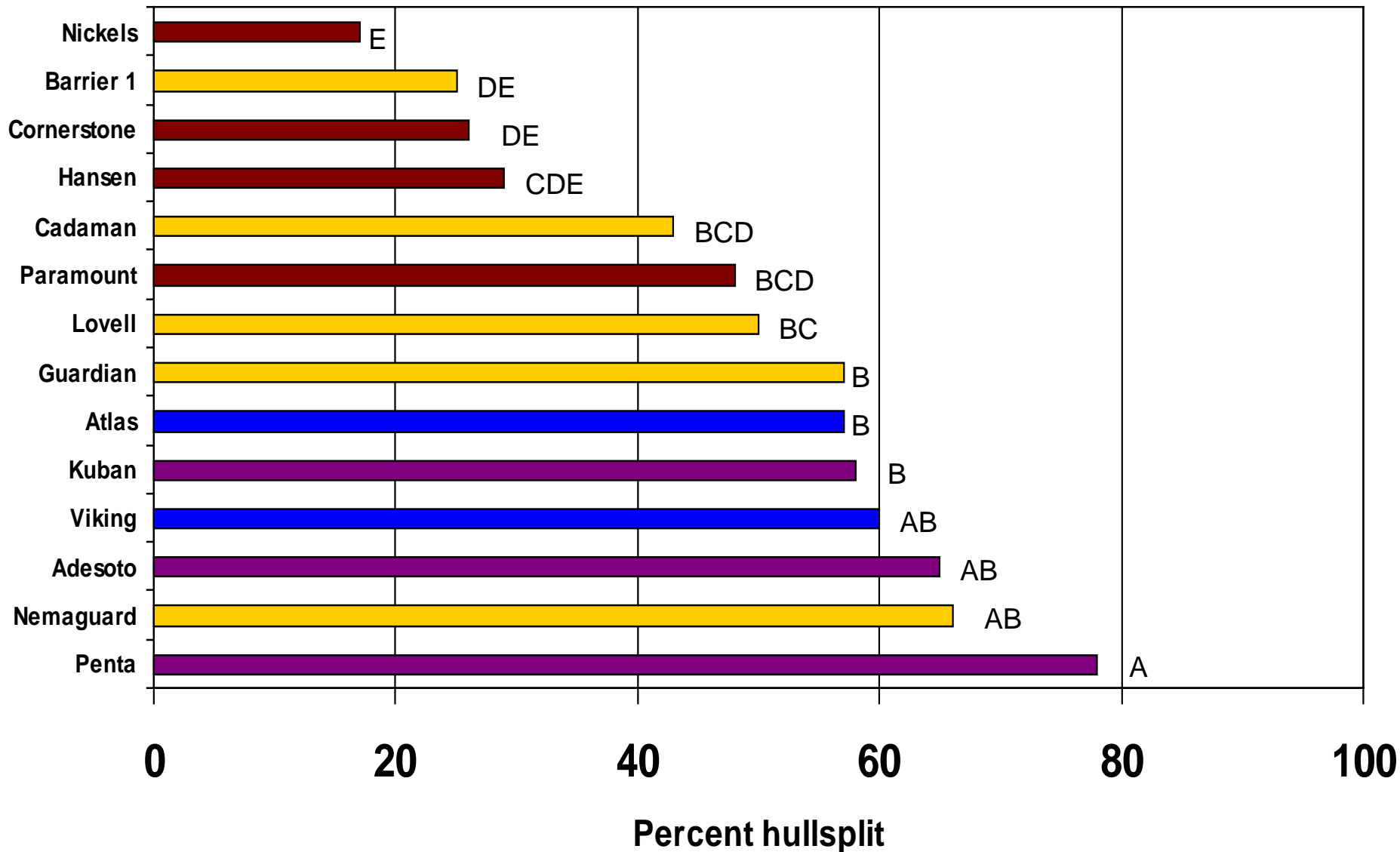
Salinity Tolerance of P/A Hybrid Rootstocks

Atwater rootstock trial, 2006

	<i>Na (%)</i>	<i>Cl (%)</i>
Nemaguard	0.64	0.22
Lovell	0.72	0.26
Hansen	0.17	0.09
Brights	0.20	0.07
Critical level	>0.25%	> 0.3%

Effect of Rootstock on Hullsplit of Nonpareil Almond.

July 30, 2008





Nickels dead from
Phytophthora –
spring 2007

Crown Gall on Hansen Rootstock





Bacterial Canker

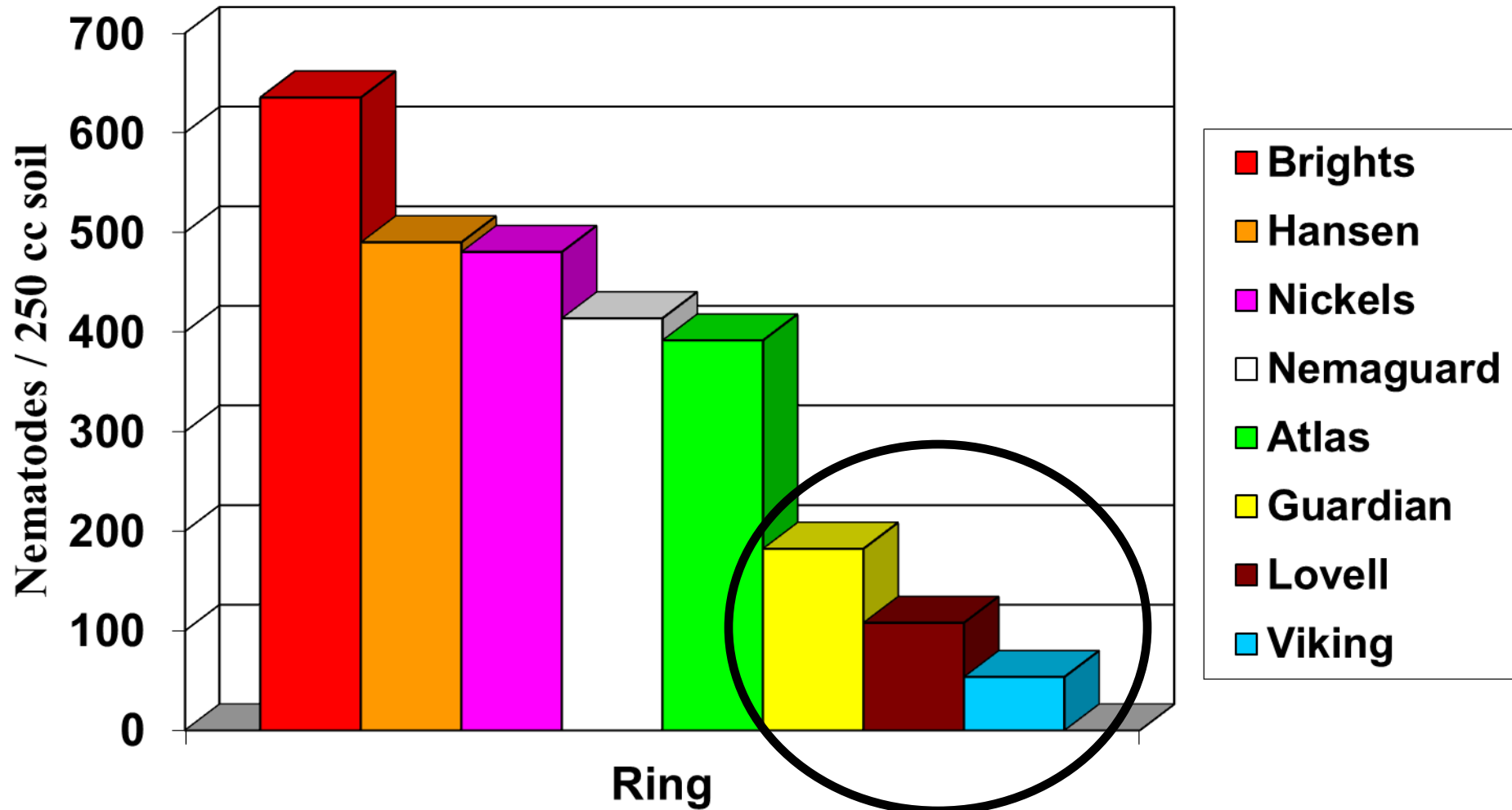
- Highly correlated to ring nematode
- Sand / loamy sand
- Replanted orchards

Complex Hybrids

- **Viking** (peach x almond x plum x apricot)
 - Similar in size to nemaguard
 - Resistant to rootknot nematode
 - Tolerant to ring nematode
 - Bacterial canker tolerance is similar to Lovell but with higher yields
 - More tolerant to high pH, sodium & chloride than peach rootstocks
 - Good anchorage

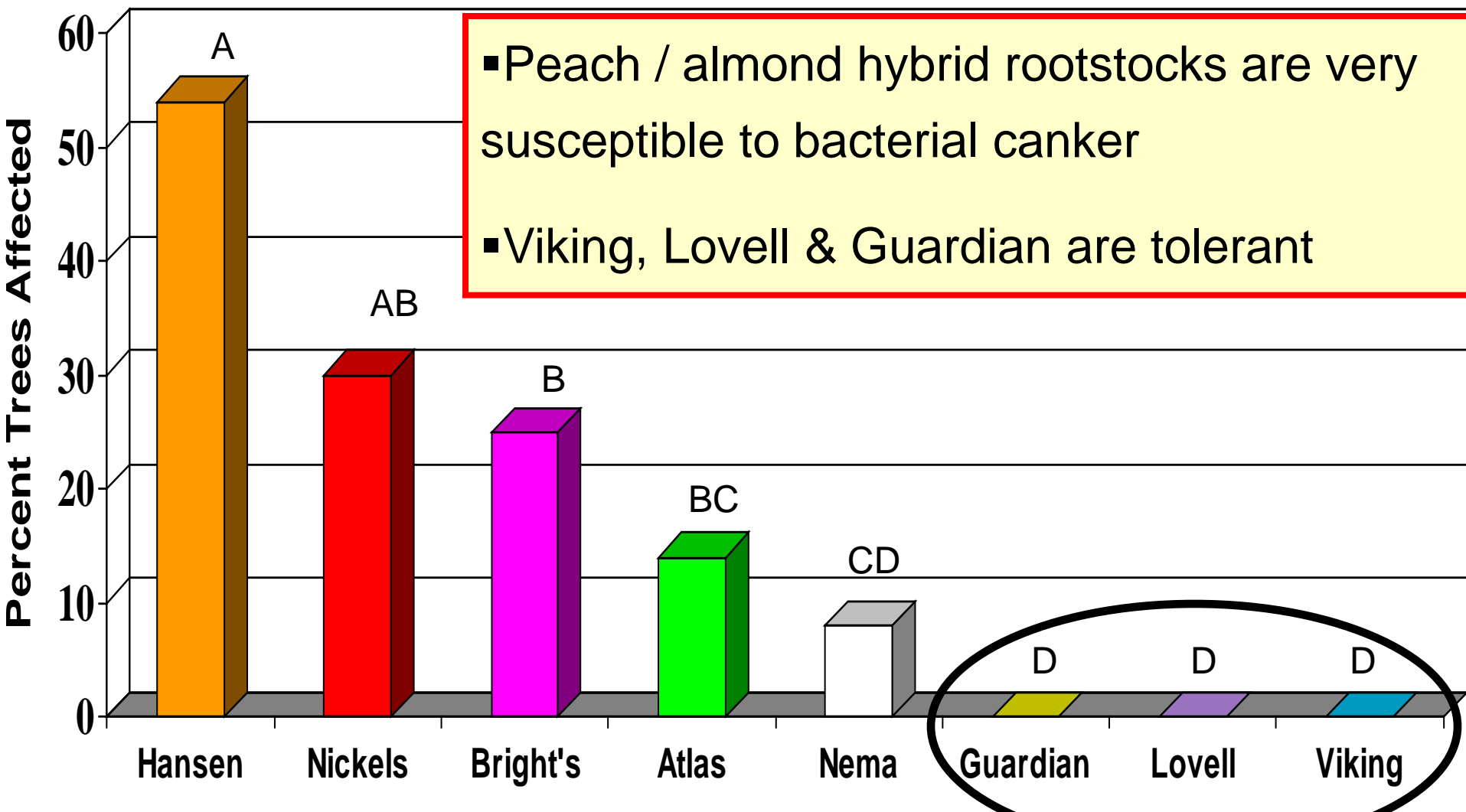
Soil Numbers of Pathogenic Nematodes as Influenced by Almond Rootstock

Escalon, CA. January, 2005



A Comparison of Almond Rootstocks for Incidence of Bacterial Canker

Escalon, CA 2005 (8th leaf)



Complex Hybrids

- **Atlas** – (peach x almond x plum x apricot)
 - More tolerant to high pH, sodium & chloride than peach rootstocks
 - Has shown high yield efficiency in several UC trials
 - Resistant to rootknot nematode
 - Susceptible to ring nematode and bacterial canker
 - Unknown susceptibility to other root diseases

Rootstock Influences on Tree Nutrition

Escalon Rootstock Trial Leaf Analyses, July 2004

Chloride (%)

Nemaguard	0.09	a
Lovell	0.08	a
Guardian	0.08	a
Atlas	0.04	b
Viking	0.04	b
Nickels	0.03	b
Brights	0.03	b
Hansen	0.03	b

Rootstock Influences on Tree Nutrition

Escalon Rootstock Trial Leaf Analyses, July 2004

Boron (ppm)

Nemaguard	47	a
Lovell	47	a
Guardian	47	a
Atlas	49	a
Viking	45	ab
Nickels	42	bc
Brights	42	bc
Hansen	40	c

Alternative Rootstocks Being Tested in Stanislaus County for Almond

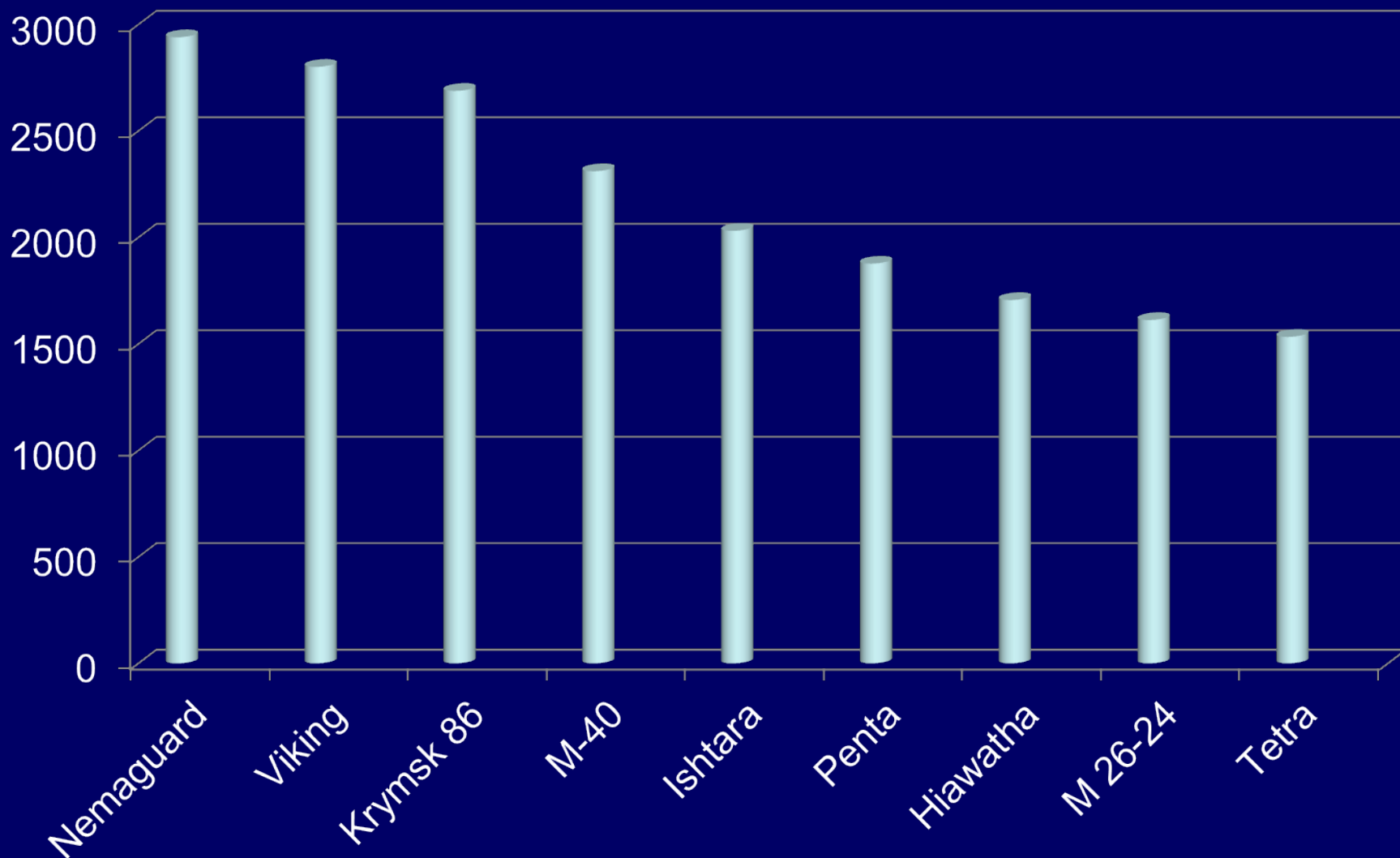
Krymsk 86 – Russia

Plum (Myrobalan) x peach

- 80 – 90% size of nemaguard (similar to Lovell)
- **Reported to be...**
 - Tolerant to heavy soils, root rot.
 - Good anchorage
 - Very little suckering
 - Appears to be very compatible with almond*

Yield of 5th Leaf Butte & Padre on Plum Rootstocks

October 2011



Alternative Rootstocks Being Tested in Stanislaus County for Almond

- Empyrean 1 (Barrier 1) – Italy

Peach

- More vigorous than P / A hybrids
- Resistant to rootknot nematode
- So far, very few ring nematodes in local trial

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Specific Challenges...

- Alkaline / salty soil or water
 - P/A hybrid (not if heavy soil or ring nematodes)
 - Hansen, Nickels, Brights, Paramount,
 - Atlas (not if ring nematodes)
 - Viking
 - Empyrean 1 or Cadaman??

Specific Challenges...

- Poor drainage / heavy soil

- ~~Marianna 26-24~~

- Krymsk 86

- Marianna 40

- Ishtara

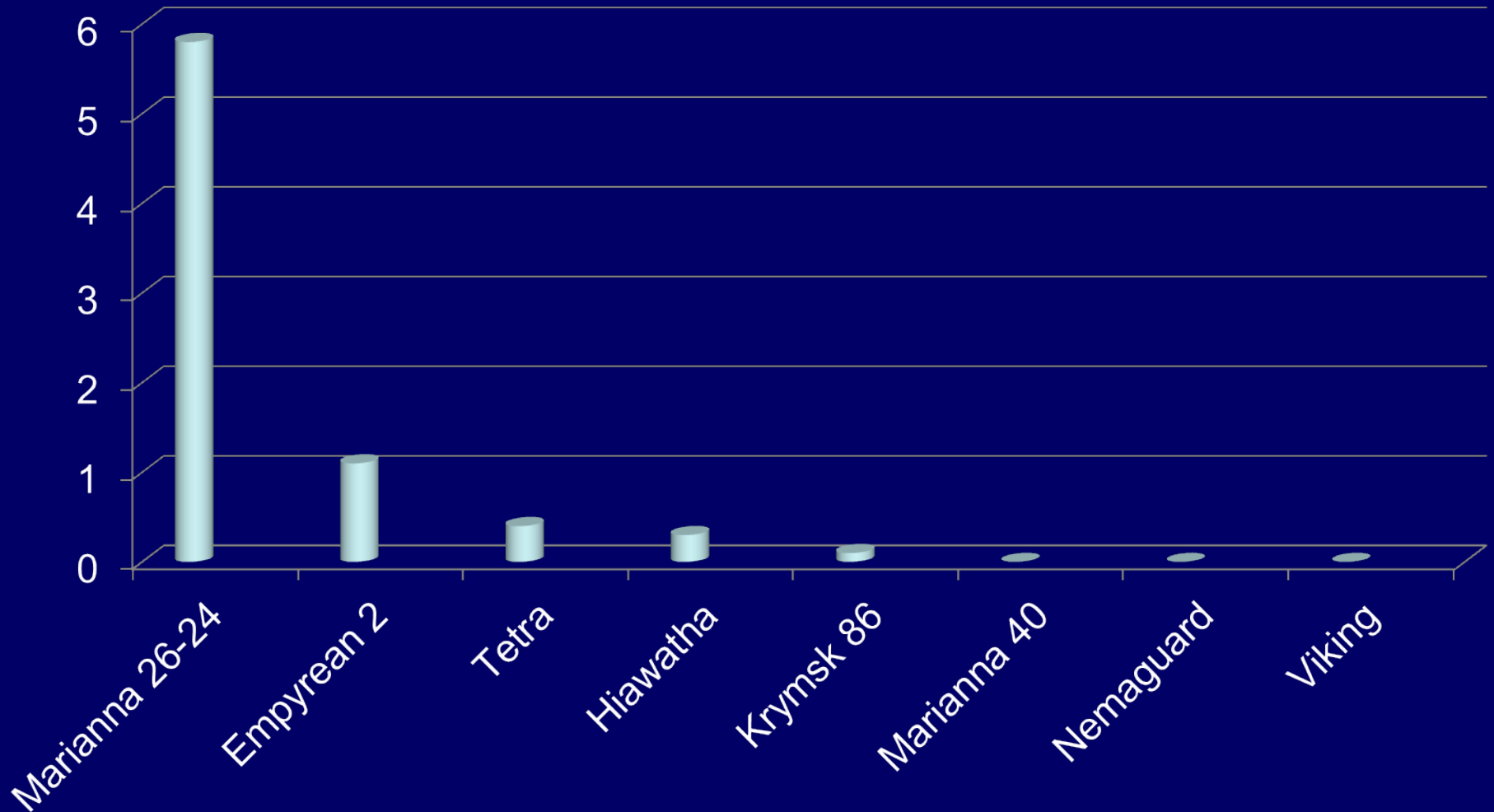


More vigorous than
M 26-24 with little
suckering

- ~~Hiawatha ? Penta? Tetra? Empyrean 101?~~

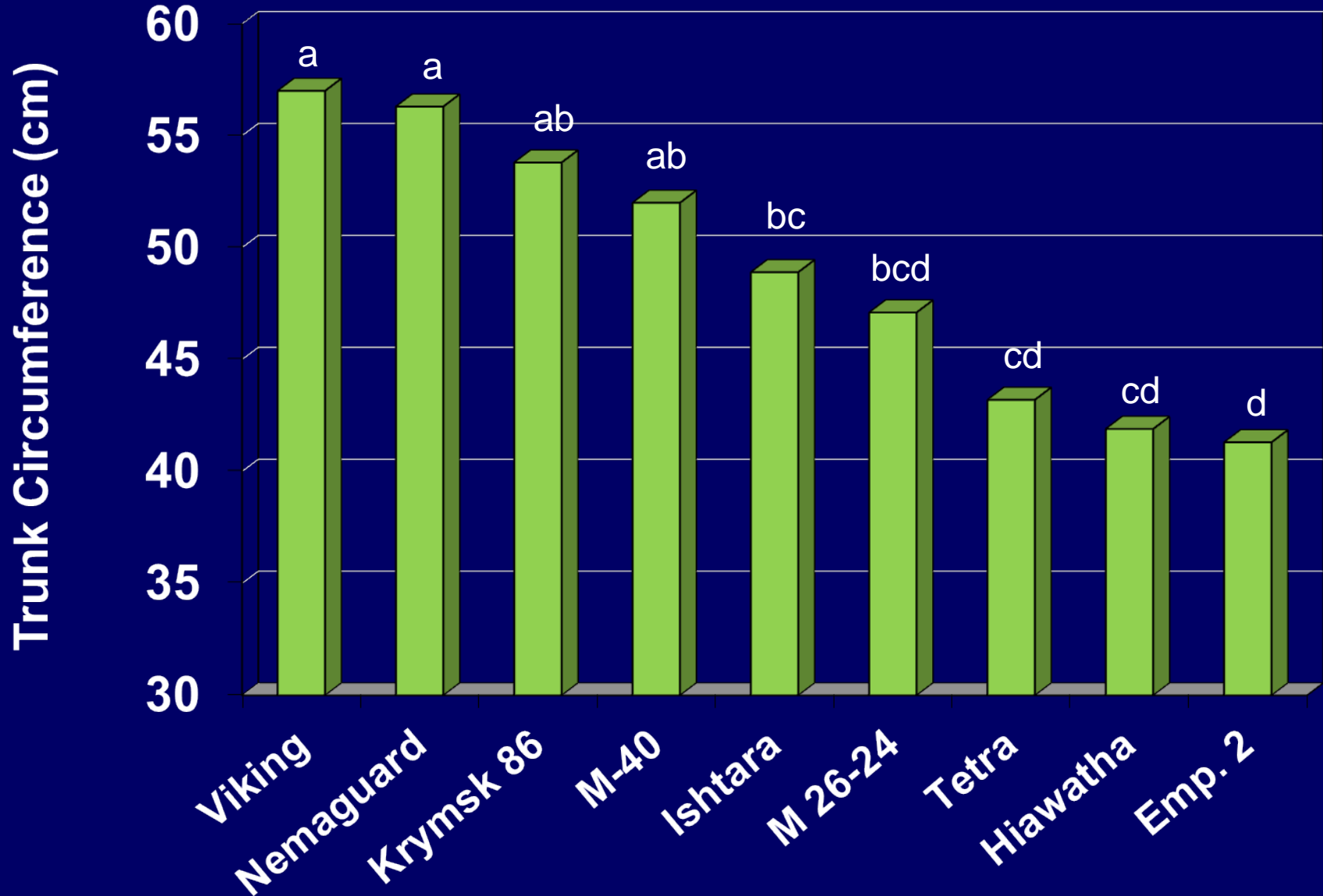
Number of Suckers / Tree

May, 2011



Rootstock Effect on Tree Size of Fourth-Leaf Butte Almond Trees.

December, 2010.



Specific Challenges...

- Oak root fungus
 - Marianna 26-24 is the only known commercially available almond rootstock with ORF tolerance

Don't ignore the bottom half of the tree!

Think about what specific challenges your ground may have and select the appropriate rootstock.

Your best offense is a good defense.

**Thank you for your
attention**